DIMENSIONS OF FIELD PREPARATION FOR DATA-INTENSIVE AGRICULTURAL RESEARCH

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OUTLINE

- Working in the field, adapting instruments and methods
- Aim: unravelling the complexities of preparing the field for automated data-intensive agricultural research
- Case study: Haly.Id
- Three dimensions influencing field preparation: environment, social relations, methods
- Differences with other types of preparation (fossil construction and non-data-intensive research)
- Conclusions

WORKING IN THE (AGRICULTURAL) FIELD

- Researchers work on nature's terms (Knorr-Cetina 1992)
  - Study of whole organisms
  - Natural objects remain anchored in their environment
  - Events must be dealt with as they occur
- Field and organisms co-exist with other life forms (Latour 1983)
- Fields serve multiple purposes
- Fields are dynamic, unpredictable, and shaped by local history (Kholer 2002)

THE NEED TO ADAPT INSTRUMENTS AND METHODS TO THE FIELD

- Lab instruments and methods designed for stable, controlled environments often fail (e.g., humidity gauges, solar radiation tools – Kohler 2002)

- Field workers must adapt them to unpredictable, violent conditions of nature
  - waterproof, lightweight, portable, robust, easy to use, able to respond to complex variable combinations

THE NEED TO ADAPT THE FIELD TO INSTRUMENTS AND METHODS

- The field is transformed to fit lab instruments and methods (Latour 1983)
- Fields are selected and manipulated: isolating variables, structuring space, controlling growth (Kohler 2002)
- Example: New Zeeland apple orchards adapted for automation (Legun and Burch 2021)
- Yet, some elements resist adjustments (e.g., soil fertility, soil type, tree vigour)

Continuous, dynamic interplay between field and technologies, each reshaping the other to achieve a workable fit

AIM

- Unravel the complexities of preparing the field for automated data-intensive agricultural research
- Activity that plays a pivotal role in laying the foundation for meaningful research outcomes
- Yet, it is not always acknowledged as scientific labour (Shapin 1989)
- It involves the meticulous construction of objects that can be investigated and used to investigate
- Process influenced by three dimensions – environment, social relations, methods

CASE STUDY: HALY.ID

Haly.Id develops an automated system generating large datasets to monitor the damage inflicted by *Halyomorpha halys* (*H. halys*) (Ferrari et al. 2023)

- Different objects – technological (drone, camera trap, sensors, RGB cameras, NIR-HIS) and natural (trees, pears, *H. halys*)

HALY.ID'S SELECTION AND ADAPTATION: INITIAL DESIGN

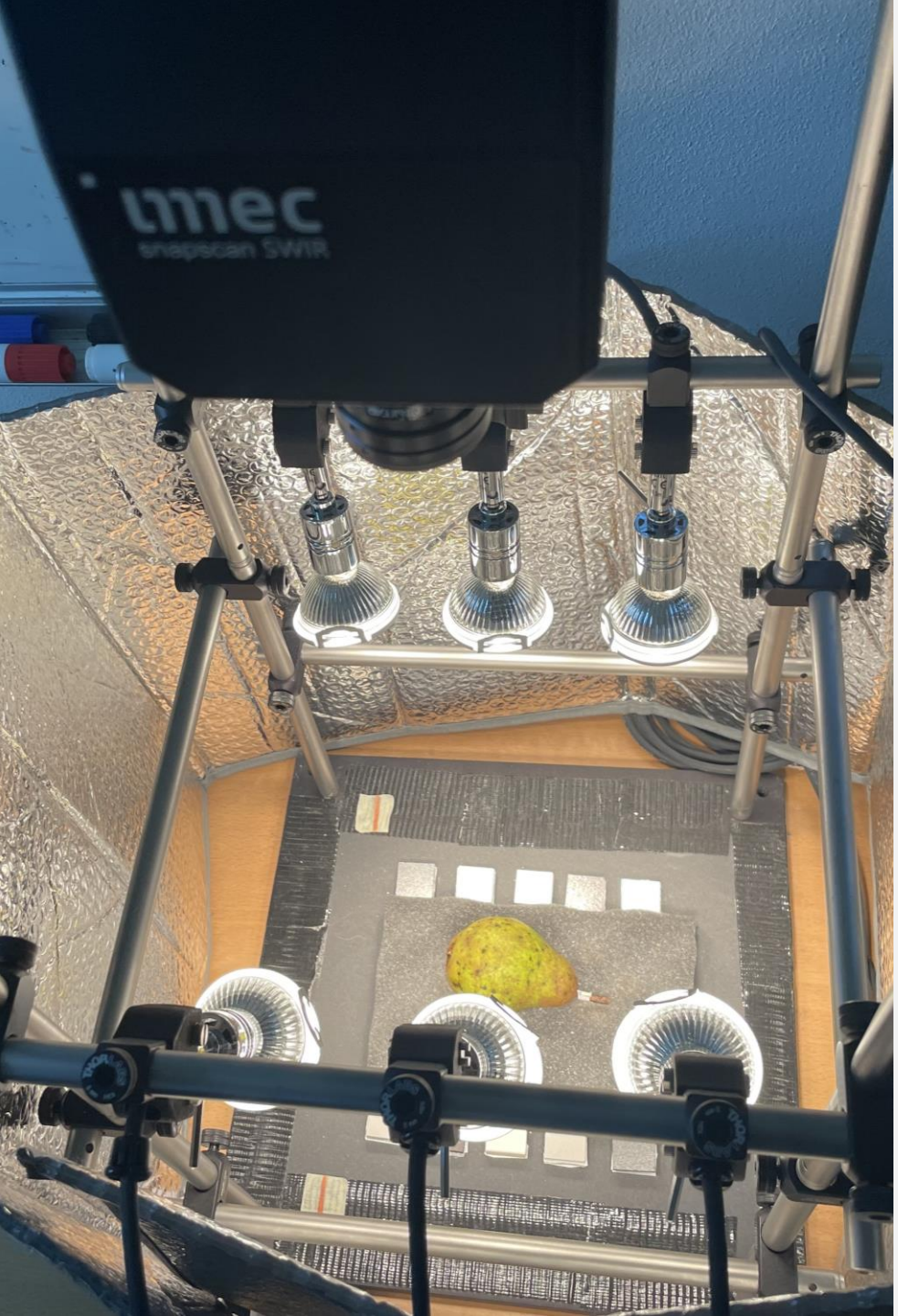
	Field	Technologies
Selection	➢ Organic – no pesticides ➢ Internet connection ➢ Farmer's passion for technologies ➢ Farmer's alternative income	➢ Drone flying above the orchard ➢ Drone not disturbing *H. halys* ➢ Precise GPS
Adaptation	➢ Plastic markers around trees ➢ Channels in the soil for wires	➢ Drone stopping at specific points based on field characteristics ➢ NIR-HSI adapted to pears

DIMENSION 1: ENVIRONMENT

- Unpredictable weather patterns (e.g., hail, rain, heat)
- Complex environmental interactions (e.g., other organisms and diseases)
- Limited control (e.g., temperature, humidity, visitors)
- Unpredictable human impact (e.g., hosting farmers' changing priorities, watering patterns, fertilization regime)

DIMENSION 2: SOCIAL RELATIONS

- Skills distinctively of the field needed
  - Ensuring steady data
  - Managing the unexpected
- Absence of standard protocols, formal training, or publications
- “Jack of all trades”: adaptability and cross expertise
- Division and integration of labour and expertise



DIMENSION 3: METHODS

- Decisions regarding:
  - Which biological aspects to monitor
  - how to align tech with field elements
  - how to tailor data collection to lab instruments

... greatly influence field preparation and object construction

- Haly.Id: system had to be both technically feasible and compatible with existing pest control methods

HALY.ID'S SELECTION AND ADAPTATION: FIELD PRACTICE

	Field	Technologies
Selection	➢ Organic – no pesticides ➢ Internet connection ➢ Farmer's passion for technologies ➢ Farmer's alternative income	➢ Drone flying above the orchard ➢ Drone not disturbing *H. halys* ➢ Precise GPS
Adaptation	➢ Plastic markers around trees ➢ Channels in the soil for wires ➢ Exclusion cages around pears ➢ Freezing days and local floodings ➢ Entomologists lacking technical knowledge ➢ Different setups in different fields	➢ Drone stopping at specific points based on field characteristics ➢ NIR-HSI adapted to pears ➢ Camera trap withstanding high temperatures ➢ Computer scientsts lacking entomological knowledge ➢ Loss of farmers' input

“PREPARING” THE FIELD

- Preparation involving the meticolous selection and adaptation of objects – natural and technological
- Environment, social relations, and methods – dimensions influencing the preparation of field and technologies to be investigated and to investigate
- Ultimately, these shape how scientists – and the rest of us – understand the world

"PREPARATION" IN CONTEXT

"Preparing evidence involves 'transform[ing]' materials to achieve physical and epistemic goals (e.g., [...] a data set that has been cleaned and formatted for a particular study)" (Wylie 2021: 8-9)

- Adaptation and iteration of objects, ideas and work
- Fossils are prepared for research: e.g., cleaned, repaired, reconstructed (Wylie 2015)
- Typically carried out in labs, isolated from the environment

VS

- Field preparation is highly situated — shaped by environment, social relations, and methods

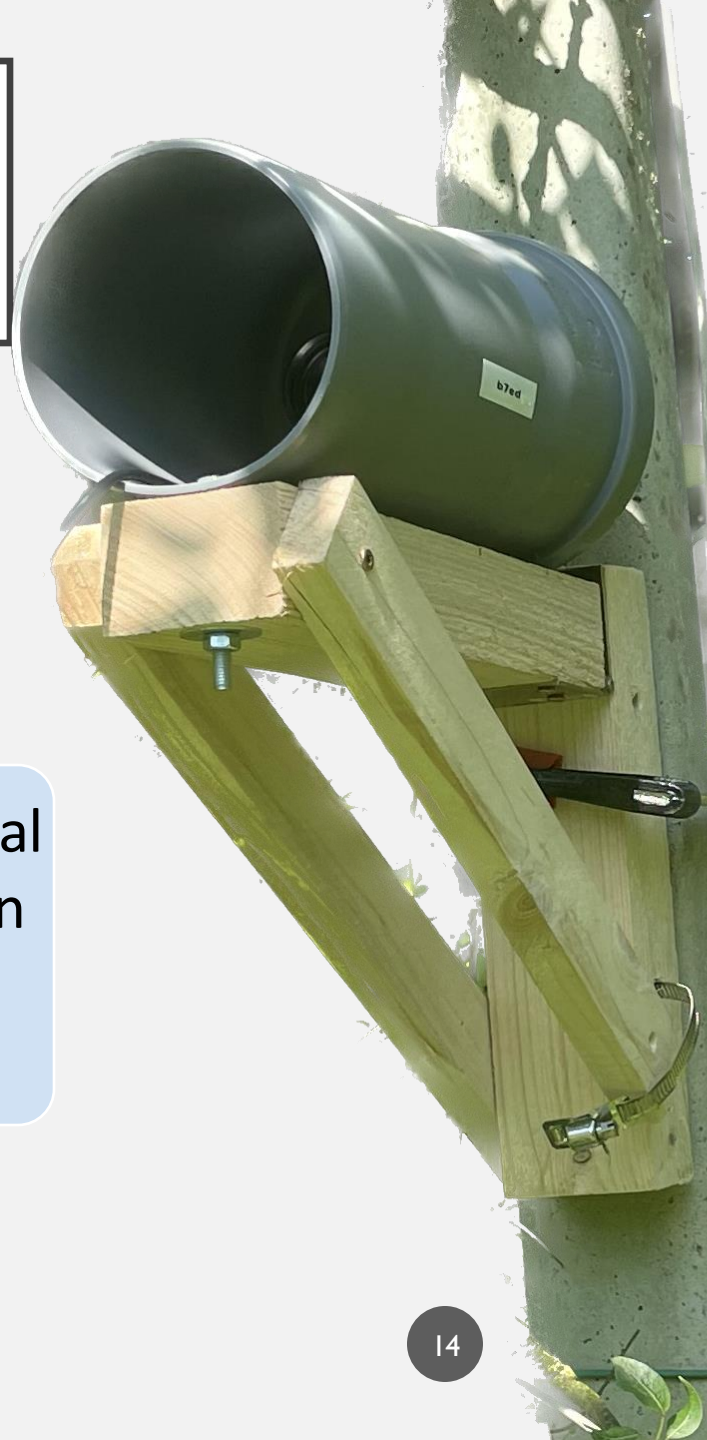
RISK OF PRIORITIZING DATA OVER BIOLOGY

Dimensions shape automated data-intensive agriculture, focusing heavily on data production and technological advancement

BUT

Risk of side-lining, at least for the moment, biological knowledge and context needed for field application (Cavazzoni and Leonelli forthcoming)

- Haly.Id collecting extensive data via camera which, entomologically speaking, is unnecessary – field knowledge overlooked



CONCLUSIONS

- Field preparation and object construction shaped by social relations, environment, and methods

- Requires adaptation between field and lab elements
  - Reconceptualizing “preparation” as key research stage
  - Balance domain knowledge, material settings, and tech in data-intensive agricultural research
  - Reassessing expertise and hierarchies to achieve that balance (e.g., via transdisciplinarity – Cavazzoni et al. 2025).

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